SECTION 15190 – FUEL SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 WORK INCLUDED

A. Provide an integrated emergency power fuel system. The specification requires the detailed system design, equipment, installation inspection, startup, and training to be the responsibility of a single specialized fuel system supplier. The specification section includes responsibility for mechanical, electrical, and control systems.

B. The system shall be in accordance with design standards and shall be designed and built to N+1 redundancy against failure.

C. Shall include:

1. Fuel storage tanks and accessories.
2. Fuel distribution pipe, valves and fittings.
3. Fuel transfer and control – duplex pump sets.
4. Tank manifold control.
5. Tank level and leak monitoring system.
6. Tank fill containment.
7. Tank fill and controls.

D. All work shall be installed in accordance with all local and State codes.

1.3 RELATED SECTIONS

A. Examine all drawings and criteria sheets and all other Sections of the Specifications for requirements which affect work under this Section whether or not such work is specifically mentioned in this Section.

1.4 REFERENCES

A. ANSI B31 - American National Standard Code for Pressure Piping.

B. API 650 - Welded Steel Tanks for Oil Storage.

C. API 2000 - Venting atmospheric and Low Pressure Storage Tanks.

D. NFPA 30 - Flammable and Combustible Liquids Code.

E. NFPA 70 - National Electric Code.

F. PEI/RP200- - Recommended Practices for Installation of Aboveground Storage Systems.

G. UL1316 – Glass Fiber Reinforced Plastic Underground Storage Tanks for Petroleum Products.

H. NFPA 1 - Uniform Fire Code.

I. IBC Fire Code.

J. ASTM D4021 – Glass Fiber Reinforced Polyester Underground Petroleum Storage Tanks.

1.5 SUBMITTALS

A. See Section 15050 and General conditions for additional requirements.

B. Mechanical System Design: Indicate system layout, pipe sizes, location of supports, elevations, and equipment mounting details. For fuel tanks, indicate dimensions, vent sizes and location of all accessories including pumps, fill pipe, manways, tank supports, inventory sensor, and leak sensors. Provide a piping and instrument diagram for the system including a complete bill of material/ equipment list.

C. Control System Design: Provide control system designs including electrical schematics, panel physical, and field wiring diagrams.

D. Structural Design: Provide drawings of reinforced concrete tank foundation slabs. Provide drawings of structural steel for walkways or pipe trestles where required.

E. Calculations: Provide calculations for pump selection, pipe sizes, and pipe support requirements. Provide calculations for size and thickness of tank hold down slab and straps.

F. Equipment Data: Provide manufacturers information for all equipment.

G. Permit Applications: Provide copies of all permit applications.

H. Schedule: Provide a design and installation schedule.

I. Commissioning: Provide a detailed commissioning plan.

J. Project Record Documents

1. Record and submit actual location of piping system, storage tanks, wiring, conduit runs and system components.

K. Operation and Maintenance Manuals

1. Operation Data: Include installation instructions and exploded assembly views.
2. Maintenance Data: Include maintenance and inspection data, replacement part numbers and availability, and service depot location and telephone number.

1.6 QUALITY ASSURANCE

A. Comply with NFPA 30 “Flammable and Combustible Liquids Code” for design and construction, installation, inspection, and testing of fuel system components and accessories.

B. Comply with NFPA 70 “National Electric Code” for equipment, wiring, and conduit installed under this section.

C. Provide equipment and accessories that are listed and labeled.

D. Welding Materials and Procedures: Conform to ASME Code and applicable state labor regulations.

1.7 QUALIFICATIONS

A. The company shall provide evidence of professional liability and pollution liability insurance.

1.8 REGULATORY REQUIREMENTS

A. Comply with requirements of the EPA and other state and local authorities having jurisdiction. Include permitting and registering of fuel storage tank.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer's installation instructions for rigging, unloading and transporting units.

B. Protect all equipment and tanks from damage after arrival at site.

PART 2 - PRODUCTS

2.1 UNDERGROUND FUEL TANKS

A. Acceptable manufacturers subject to compliance with the specifications:

1. Containment Solutions

2. Xerxes
3. Edwards FRP Tanks

B. General

1. Provide and install underground fiberglass tanks with primary and secondary walls. The tank and its containment shall be listed as an assembly by Underwriters Laboratories. The primary tank shall have a total volume as noted on drawings.

C. Design Criteria

1. Primary Tank: The primary tank shall be approved per U.L. Standard and meeting the requirements of N.F.P.A. 30. The tank shall be warranted for 30 years by the manufacturer.
2. Secondary Containment with Leak Monitoring: The secondary tank containment shall provide at minimum 100% containment of the primary storage tank. The interstitial space shall allow liquid to migrate through it to a monitoring point. A leak detection access tube shall be located in the interstitial space between the inner tank and the secondary barrier.
3. Hold-Down Construction: Tanks shall be designed for stability with a water table at grade. Tank anti-flotation calculations shall be submitted for approval. Glass fiber reinforced hold down straps shall be provided by the tank manufacturer.
4. The tanks shall be listed for use with #2 fuel oil.
5. Tank Fittings: All product fittings shall be heavy duty steel threaded flanges (NPT or Raised Face Slip-on weld flanges (RFSO). Steel wear plates 1/4" thick shall be under all product fittings.
6. Monitor Fittings: Monitor tubes with 2" NPT fitting (or larger) shall be located within the tank according to manufacturer's UL listing to access/monitor the interstitial space.

D. Tanks and their installation shall comply with the latest edition of the following Standards:

1. National Fire Protection Assoc. (NFPA 30) Flammable and Combustible Liquids Code and (NFPA 31) Standards for Installation of Oil Burning Equipment.
2. Factory Mutual.
3. City of Portland, Maine Codes and Regulations.

E. Submittals:

1. Shop Drawing & Catalog Data: Contractors shall submit copies of the shop drawing and literature for each tank. Drawings shall include all critical dimensions and show locations of all the fittings and accessories, i.e., manways, ladders, hold-down straps, etc. Materials of construction shall be in accordance with this specification. All underground piping must be submitted for review by the Engineer and Owner.
2. After fabrication each tank shall be pressure or vacuum tested as specified in the following sections. The tank shall have securely affixed thereto, a metal plate or tag which has legibly indicated thereon the maker's name, address, metal gauge (if

applicable), weight in pounds of the completed tank, and the capacity in gallons. Tanks shall have piping connections and fittings as shown on the drawings.

3. Before leaving the shop, tanks shall be thoroughly cleaned of all foreign matter. Tanks shall bear U.L. label and shall be manufactured according to U.L. requirements.
4. The location of the underground tanks and piping shall be clearly marked at grade during the construction period to prevent damage.
5. Installation Instructions: Contractor shall submit 3 copies of the manufacturer's latest installation charts.
6. Calibration Charts: Contractor shall submit 3 copies of the manufacturer's latest calibration charts.

F. Product Storage Requirements:

1. All primary tanks must be vented. Tanks are designed for operation at atmospheric pressure only, except for the use with vapor recovery systems at a pressure or vacuum of approximately 1 psi.
2. Tank shall be capable of storing petroleum products with specific gravity up to 1.1.
3. Tanks shall be chemically inert to petroleum products.

G. Interstitial Monitoring Requirements:

1. Tanks shall have interstitial space between the primary and secondary shell to allow for the free flow and containment of all leaked product from the primary tank. Space shall also allow for the insertion of the Monitoring device through a monitoring fitting, as hereinafter specified. The interstice shall be sealed (non-vented to atmosphere).
2. Tanks shall have an integrally mounted reservoir installed on the tank for hydrostatic monitoring. The reservoir shall be constructed of fiberglass reinforced plastic materials and warranted for 30 years against failure due to internal/external corrosion and when properly installed, against structural failure.
3. Tank shall be designed with one 4" fitting that will access the tank bottom between the primary and secondary walls (annular space).
4. The double-wall tank monitor shall be capable of detecting a breach in the inner and/or outer tank under the following installed conditions:

    a. When the inner tank is empty.
    b. When the inner tank is partially or completely full and the groundwater table is below the tank bottom.
    c. When the inner tank is partially or completely full and the tank is partially or completely submerged in groundwater.

5. The leak detection performance of the hydrostatic monitoring system shall be tested and verified by a qualified independent consultant to detect leaks as small as 0.10 gallons per hour within a one month period.
6. All monitoring equipment, including FRP reservoirs and electronic controls, shall be UL listed or accepted.

7. The hydrostatically monitored, solution used in the tank annular space shall have UL approval for compatibility with the tank and be a contrasting color to the tank surface to facilitate visual inspection of the tank for leaks prior to burial.

H. Factory Testing

1. Factory final testing and record keeping by tank manufacturer: The finished tank assembly shall have the interstice pressurized to 2 psi and the entire exterior surface shall be soap bubble tested to be shown pinhole free. The interstice shall then have a vacuum of not less than 10" of mercury (hg) applied for a period of one hour without change. A vacuum of not less than 10" hg shall be maintained on the finished tank during storage, shipping and delivery to job site. A pre-ship 12,500 minimum volt test shall be performed prior to the tank being loaded for shipment.

   a. All final tests and dimensions shall be recorded, singed and dated by the Quality Control Inspector on the inspection sheets and inspection drawings. Inspection sheets, drawings and other documents concerning construction and testing shall be maintained in a permanent file. Each tank shall be entered into the UL Label Log and the Plasteel Registration Log.
   b. Tank tightness testing: The tank manufacturer shall provide a tank installation tightness test method using an interstitial vacuum. This method must be third party evaluated per the EPA Non Volumetric Tank Tightness Method and comply with 40 CFR, Part 280, Paragraph 280.43 (c).

I. Installation instructions: Tank manufacturer shall supply UL Listed Instructions and a kit of materials and resin for sealing all exposed metal during tank installation. Tank to be installed per NFPA-30, applicable state and local codes, and manufacturer's instructions.

J. Tanks shall be tested and installed with pea gravel or crushed stone as specified in the current installation instructions provided with the tank. When an oil tank is in place with the hold-down straps secured in final position, the hold-down straps, turn buckles and all exposed metal fasteners shall be cleaned, primed and finished with one coat of heavy enamel asphaltic paint. Number and location of straps shall be as specified by tank manufacturer. Each strap shall be capable of withstanding the buoyancy load for tank diameter. The HVAC Contractor shall perform leak tests as specified in the following sections prior to back-filling. Tank to be certified to have passed or shall be replaced if the tank fails the tests. Provide test certification to the owner. Test to be witnessed by the Fire Department and owner. Hold down concrete pad to be provided by the applicable section, not the HVAC Contractor. All backfill material shall be provided, as per the tank manufacturer's requirements, by the applicable section as assigned by the Construction Manager, not the HVAC Contractor.

K. Loading Conditions - Tanks shall meet the following design criteria:

1. External hydrostatic pressure. Buried in the ground shall meet all the requirements in NFPA 30 2-4.1 through 2-4.3.
2. Internal load: Tanks shall withstand a 5 PSI air pressure test with 5 to 1 safety factor. Contractor shall test tank, prior to installation, to test for leakage. Maximum test pressure is 5 PSI.

3. Vacuum Test: To verify structural integrity, tank shall be vacuum tested by the manufacturer, at the factory, to 11.5 inches of mercury. Tanks to be delivered to job site under vacuum to insure tank integrity after shipment.
4. Surface loads: Tanks shall be capable of withstanding soil/pea stone cover, AASHTO and H-20 axle loads (32,000 lbs./axle), when properly installed according to current tank manufacturer's installation instructions.
5. Internal load; Primary tank annular space shall withstand independent pressure test (NFPA 30, 2-8.3.1) of 3 to 5 psi or vacuum at 5.3 in. Hg. on tanks 4' through 10' diameters. Resulting in a 5 to 1 safety factor.
6. Tanks shall be designed to support accessory equipment such as ladders, drop tubes, etc. When installed according to the manufacturer's recommendations and limitations.
7. Tank laminate shall include silica treated with silane.

L. Tank Lifting Lugs:

1. Provide lifting lug(s) on all tanks. Lugs shall be capable of withstanding weight of the tank with a safety factor of 3 to 1.

M. Fitting Pods

1. Fitting pods shall be factory installed at the locations shown in the tank drawings.
2. Double-wall fitting pods will include a 2" NPT half coupling steel fitting for monitoring the upper compartment.

N. Fittings Threaded:

1. All threaded fittings on U.L. labeled tanks for storage of petroleum products shall be located in the manway lid(s) or fitting pods and be constructed consistent with the requirements of the U.L. label. Fittings to be supplied with the threaded cast iron plugs.
2. All standard threaded fittings to the primary tank and monitoring cavity shall be 4" in diameter. The secondary containment couplings shall be 6" in diameter. All standard threaded fittings shall be half coupling. Reducers are to be used for smaller sizes where specified and provided by contractor.
3. Thread Standards - All threaded fitting shall have machine tolerances in accordance with the ANSI standard for each fitting size.
4. Strength - NPT fittings will withstand a minimum of 150 foot-pounds of torque and 1,000 foot-pounds of bending, both with 2 to 1 safety factor.
5. Suction Line - Shall be installed on site by the contractor. Diameter of pipe, grade and schedule as called out on the drawings.
6. Return Line - Shall be installed on site by the contractor. Diameter of pipe, grade and schedule as called out on the drawings.
7. All rigid internal piping shall be terminated 4" from the bottom of the tanks.

O. Storage tank fill lines and sounding lines shall each terminate in five gallon Spill Containers, each including a composite top-seal, Tight Fill Adapter and Locking Fill Cap. To prevent damage from frost heave, normal settling or roadway traffic, the spill compartment shall have a flexible bellows protected by a ribbed gravel shroud. The spill compartment shall be readily removable to allow soil testing directly through the spill container without breaking concrete. The drain valve shall close with tank pressure to help prevent leakage during tank testing and filling. Spill draining is through an internal passage. The Spill Container shall be Preferred Utilities Manufacturing Corporation, Danbury, CT. Model Type l, EMCO Wheaton, Fairfield Industries or OPW.

P. FRP Piping Sumps

1. The Contractor shall provide liquid tight surface sump, to be installed under the street manholes, for access to the tank's plumbing components and tank access manhole. Sump shall be supplied and installed in accordance by the tank manufacturer's most current installation instructions.
2. The sump shall be of a design that it shall be capable of moving up or down within the skirt of the street manhole to prevent stresses to the tank in the event of tank or surface movement.
3. The sump and all of its accessory components shall be chemically compatible with the products stored.
4. The sump and all of its accessories which come in contact with the surrounding environment shall be made of materials that are non-corrosive.
5. The sump shall be of such a design and material that it shall not collapse or deform due to ground water or backfill pressure.
6. The sump shall have a means of providing liquid tight pipe entries through the wall of the sump. These sealing devices shall be capable of maintaining liquid tightness while allowing pipe entries.
7. Piping shall be installed to allow access into the tank without obstructions.

Q. Provide a skirted street manhole covers sized properly to provide access to the piping sump and tank access manhole cover. All manways shall be weatherproof and leak proof, furnished complete with U.L. listed gaskets, bolts and covers. Manhole shall be heavy duty suitable for H-20 axle loading.

R. Furnish and install for the fuel oil tank a galvanized cast iron vent protector. Vent protector shall be the full size of the vent pipe, and shall be in accordance with NFPA-30 2-4.5.2. Vent protector shall be as manufactured by Preferred Utilities Mfg. Corp., Universal or OPW.

S. Furnish and install inside the building, at the high point of the oil suction line from the fuel oil tank a U.L. listed Anti-Syphon Valve. Valve shall be sized to meet the flow requirements and shall be equipped with a spring to match the vertical distance between the highest oil storage level, of the main tank, and the inlet to the fuel oil pumps. The Anti-Syphon to be installed only if the centerline of the fuel oil transfer pump is below the top of the main oil storage tank. Valve shall be as manufactured by Preferred Utilities Mfg. Corp., Universal or OPW.

T. Provide manholes and appropriate drop tubes for easy access to tank gauge assembly and the leak detection probes. Tank gauge assembly and the leak detection probes shall not be

covered by the back fill. Manholes shall be as supplied by Preferred Utilities Mfg. Corp. Model TG-MH-18(leak detector) and TG-MH-24(tank gauge assembly) or OPW.

U. The sounding line shall terminate in a locking fill cap arrangement to accommodate a standard padlock and protected with a water right cast iron steel box set in a concrete pad. The assembly shall be Model 126 as manufactured by Preferred Utilities Manufacturing Corp. or OPW.

V. Each Tank, Fill, Vent, and Sounding Line shall be suitably identified by a one-piece cast bronze Name Plate, approximately 3" X 6" with polished raised letters.

W. Provide where shown in the fuel oil supply line a quick-closing, spring loaded, Lever Gate Valve held open by a wire with fusible link arranged so that the valve will automatically close if the link melts. Valve shall be Type 110 as furnished by Preferred Utilities Mfg. Corp. or Morrison.

X. Provide and install on the tank suction stub a bronze, 1-1/2" Double Poppet Foot Valve, with lapped-in seat, double guided poppet stems and 20 mesh monel screen. Double Poppet foot Valve shall be as supplied by Preferred Utilities Mfg. Corp. Model Type 22. The foot valve shall come with a 233-FV foot valve extractor fitting which shall allow for easy access to and repair of the foot valve. The 233-FV foot valve extractor fitting shall come with an extractor wrench of the appropriate size.

Y. Provide at the end of the oil supply loop a diaphragm type Back Pressure Regulating Valve, to control the upstream pressure of oil. Valve shall have cast-iron body for pressures to 300 psi, bronze trim and neoprene diaphragm with adjustable range of 1 to 5 psi. The valve shall be sized to match the flow rate and available discharge pressure, Type V as furnished by Preferred Utilities Mfg. Corp. or OPW.

Z. Tank Gauging, Leak Monitoring & Overfill Prevention system as follows:

1. Provide and install for each new double-wall main storage tank, a remote, microprocessor based tank gauging and leak monitoring system. Accurate to a minimum of ± 0.3%, the system shall include a microprocessor based central processing and indicating instrument, vertical lift fluid level sensor and leak detectors where indicated on drawings. The entire system and all components shall be intrinsically safe as approved by Factory Mutual for Class 1, Div. 1, Group C & D hazardous locations.
2. Central Processing and Indicating Instrument: The instrument shall have a die-cast aluminum ( 0.2” thick min.) housing containing all calibration adjustments. The system shall provide a 4-20 mA output proportional to tank content in gallons and isolated alarm relay contacts for leak detection, automatically silenced overfill alarm and common alarm (leak, overfill, and low level). The control panel shall also have the following features: LED display shall have the capability to display (without scrolling) up to 99,990 gallons of inventory. It shall display the tank content continuously. Additionally it shall display all alarms in English language. Dedicated push button for instantaneous display of the height of liquid in tank in inches. Common audible alarm with associated alarm silence push button. Data recall push

button to provide instantaneous display of tank content at the time of leak alarm condition. Overfill alarm circuit test push button to provide instantaneous proving of audible and visual alarm circuitry associated with instrument overfill alarm contact. The central processing and indicating unit shall be Preferred Instruments Model TG-EL-D3-ARF, Heresey Measurement or Metritape.

3. Mounting: TG-EL-D3 tank gauge and leak detection system shall be factory wired and flush mounted in the fuel oil management as herein specified.
4. Wiring: Use 20 gauge wiring and tape all exposed shields. Connect shields only where shown on the electrical submittals supplied by the manufacturer. Do not run low voltage wiring in conduits with high voltage (i.e., 110 volts).
5. The Liquid Level Sensor shall consist of an aluminum, submersible (NEMA 6P) electronics head external to the tank and a float internal to the tank. The float shall be connected to the sensor head by a flexible stainless cable. The flexible cable shall allow installation or removal when overhead obstructions are present. The sensor shall include an external test mechanism to allow overfill alarm and full tank calibration checks without removing the sensor from the tank.
6. Tests that electronically simulate a high tank level instead of physically moving the float are not acceptable. The sensors operation shall be unaffected by internal tank obstructions located outside of a 14" diameter cylinder extending from the tanks top to its bottom, and centered on sensor's mount. The assembly shall mount to the tank through a standard 4" 125/150 lb. flat faced flange opening with standard bolt pattern. The mechanism's control head shall be constructed of 1/4" cast aluminum. This sealed transducer housing shall encapsulate all transmitter electronics in a non-conductive oil and be moisture tight. Sensors assembly shall be water resistant and capable of operating in a submerged or manhole environment without damage.
7. The unit shall be capable of easy installation and maintenance with only 14 inches of clearance between the flange and any overhead obstructions. If buried suitable access for removal of the wire float assembly must be provided. Tank gauge calibration shall be possible at any tank fluid level (empty, part full, or full.) The sensor operation and accuracy shall be unaffected by changes in the specific gravity of the tank liquid, and be suitable for use with non-corrosive fluids and fuels up to and including No. 4 fuel oil. Supply a 4" bung fitting for installation of the level sensor. Model as specified: Preferred Instruments Model TG-EL-WF-12.
8. Each tank shall have a dry interstitial space between the primary and secondary shell to allow for the free flow and containment of all leaked products from the primary tank. The Leak Detectors shall be solid state and discriminate between oil and water, display the leak with (2) LED's on its indicating transmitter, and send an appropriate alarm signal to the instrument. All leak sensors shall be intrinsically safe, have continuous electronic checking, fail safe to an alarm condition, and have indicating transmitters with a magnetic test mechanism at grade level to exercise the sensors and check the indicating instrument response. Test systems that bypass the sensors or rely only on electronic simulation are unacceptable. Leak sensors shall be mounted (3 at the annular space within each double wall tank, 3 at each polyethylene piping sump. **Note:** Double wall containment piping shall be pitched back toward the sumps) as shown on the drawing. Leak sensors shall be Preferred Instruments HD-A1.

a. If the HD-A1 is to be mounted in manways, manway sumps, steel tanks, floor or vault containment areas, include the HD-HSG Sensor Guard. The HD-HSG is designed to protect the HD-A1 sensor from mechanical damage and from exposure to direct sunlight. The sensor and sensor guard form an assembly that can be placed at the low point of a collection sump such as a manway, piping sump, steel tank leak monitoring sump, etc.

b. Wiring: Use 20 gauge wiring and tape all exposed shields. Connect shields only where shown on the electrical submittals supplied by the manufacturer. Do not run low voltage wiring in conduits with high voltage (i.e. 110 volts).

9. Install Overfill Alarm Fill Station where shown near the tank fill terminal an overfill alarm and silencing station. The alarm station shall have NEMA 4 construction and contain 4 inch weatherproof bell and silencing push-button. An overfill alarm signal from the instrument shall sound the bell. If the fill operator does not manually silence the bell, in one minute it will silence automatically. The overfill station will have a "pre-fill" test push-button to insure the tank gauge and fill alarms are operational. The alarm station shall be as manufactured by Preferred Instruments with two (2) Models: FA-AV-2-D2 panels. Overfill alarm panel shall additionally include a digital tank contents readout which reads directly in gallons 0-150,000, without multiplier.

10. Provide and install where directed a Fil-A-Larm Sign. The sign shall be 20 inches wide by 14 inches high of 18 gauge steel with porcelain baked enamel finished bright yellow background and minimum 2 inch high black lettering. Sign shall be as manufactured by Preferred Utilities Mfg. Corp. Model FA-S. Caution Sign Shall Read: **CAUTION WHEN ALARM BELL SOUNDS OIL TANK FILLED TO CAPACITY DO NOT OVERFILL.**

11. Back-up Overfill Prevention High Level Switch shall be arranged to sound an alarm and activate the overfill alarm via the Fuel Oil Management Center PLC logic when the liquid level reaches 90 percent of tank capacity. Unit shall be stainless steel lever float operated, suitable for #2 oil at 150 psi, have brass and Buna N wetted parts, and be mounted in a 1 1/4" tapping in the tank top. Switch shall be hermetically sealed, magnetically linked to the float mechanism and fully isolated from tank contents and external atmosphere. Electrical connections shall be made externally to the tank in an explosion-proof head assembly approved by UL for Class 1, Group D applications. Switch shall be as manufactured by Preferred Utilities Mfg. Corp. Model: HLS-LS-1.

AA. Gauge installation requirements:

1. Contractor must adhere strictly manufacturer's installation procedures. Factory startup and calibration to be included for tank gauging and leak detection system by Gauge manufacturer. This requirement shall not be waived by the Contractor.

## 2.2 FUEL DISTRIBUTION PIPE- ABOVEGROUND

A. General

1. Provide and install steel piping aboveground as indicated on the drawings:

    a. In Boiler Room.
    b. In emergency generator enclosure.

2. Fuel pipe connections shall be welded except where required to be threaded at tanks or specialized valves.

B. Design Criteria

1. Steel Pipe: ASTM A53 or A105, Schedule 40 black.
2. Fittings: ASTM B16.3, 300 lb. threaded malleable iron, or ASTM A234, forged steel welding type.
3. Finish: Prime and finish paint with industrial enamel.

C. Accessory Equipment

1. Unions: 300 lb. malleable iron threaded unions.
2. Ball Valves: Steel construction, two piece body, chrome plated steel ball.
3. Swing Check Valves: Bronze body, bronze swing disc, threaded ends.
4. Swing Check Valves with Integral Pressure Relief Valves: Bronze body, bronze swing disc, Teflon seat, steel stem and springs, automatic, direct, pressure actuated at maximum 40 PSI, threaded ends, UL listed for fuel.
5. Anti-Siphon Valves: Bronze body, bronze swing disc, spring loaded, normally closed, threaded ends, size to resist static siphon head.
6. Solenoid Valves: Bronze, "0" PSIG pressure differential, normally closed or normally open per plans, NEMA 7, explosion proof and watertight, threaded ends.
7. Emergency Shut-Off Valves:

    a. Provide a fusible link Emergency Shut-Off Valve or valves as indicated.

8. Flexible Connectors: Stainless steel inner hose and braided exterior sleeve, suitable for minimum 200 psi WOG and 250 degrees F.
9. Inwall Spill Container: Fill line shall terminate in a flush mounted 304 stainless steel spill container with piano hinged door with lockable handle. Provide tight fill adapter and cap.
10. Containment pipe leak sensors: Provide where shown on the drawings a leak sensor at each low point on the containment piping within the building.

2.3 FUEL DISTRIBUTION PIPE AND PIPE FITTINGS, SECONDARY CONTAINMENT

A. Acceptable manufacturers subject to compliance with the specifications:

1. Rigid Piping Systems:

a. Perma Pipe
b. Insul Tek
c. Ameron
d. AO Smith
e. Ravanco

2. Flexible Underground Piping Systems

a. Total Containment, Inc. Enviroflex System
b. Environ
c. APT

B. General

1. Provide for all piping located:

a. Underground
b. Aboveground

1) All other than:

a) Boiler Room
b) Generator Enclosure

2. Above ground; within building and required by local code, schedule 10 steel pipe shall be used instead of fiberglass pipe for secondary containment.

C. Rigid Fuel Oil Piping shall conform to the following:

1. The requirements of this paragraph apply to interior, underground and exterior fuel oil supply and return system. Piping systems shall be an engineered and totally prefabricated double-pipe type system. Product pipe shall be protected from the exterior environment by the secondary containment. The system supplier shall have minimum (5) years of experience in the manufacture of secondary contained pipe systems. All straight sections, fittings and other accessories shall be factory prefabricated to job dimensions and designed to minimize the number of field connections. Secondary containment joints completed at the factory shall be 100% air tested and leakproof. The containment shall be drainable and air pressure testable.
2. Trained field representatives of the piping supplier shall provide technical field support during critical periods of installation including final check-out of the system.

3. Product pipe shall be standard weight carbon steel, ASTM A53, Grade B, ERW or seamless. All joints shall be butt welded for sizes 2 1/2" and greater, and socket or butt welded for 2" and below.
4. For all containment piping, the secondary containment shall be fabricated out of carbon steel in accordance with ASTM A139, Grade B, ASTM A120, Grade B or ASTM A53, Grade B, to the thickness specified below:

| Diameters | Minimum Thickness |
|---|---|
| 3" to 5" | Schedule 40 |
| 6" to 26" | 10 Gauge |

The containment casing shall be coated with Epoxy to a minimum thickness of 20 mils. The epoxy coating shall be reinforced with two alternate layers of fiberglass cloth in such a manner as to fully impregnate each layer with epoxy as the layers are applied.

5. Support spacing shall be determined by the manufacturer based on pipe diameter, pipe material, and operating temperature of the product pipes. In all cases, pipes within the secondary containment shall be supported at not more than 10'-0" intervals. These supports shall be designed to allow for continuous airflow and drainage of the secondary containment in place.
6. End seals and other sub-assemblies shall be designed and factory prefabricated to prevent the ingress of moisture into the system. All sub-assemblies shall be designed to allow for complete draining of the secondary containment.
7. The HVAC Contractor shall install the system in accordance with the directions furnished by the manufacturer and as approved by the Architect and Engineer. The secondary containment shall be air tested at 10 psig, and the product piping shall be hydrostatically tested to 50 psig or 1.5 times the operating pressure, whichever is greater. The test pressures shall be held for at least (1) hour. The HVAC Contractor shall strictly adhere to the installation guidelines supplied by the system manufacturer and shall keep the secondary containment system clean and dry at all times during the installation process.
8. Leak Detection System

    a. Provide a complete leak detection system for the piping to ensure that any leaks in any oil piping or storage facility including day tank basins and on the floor of the mechanical room fuel oil transfer room, are alerted and alarmed. The system must be installed in strict accordance with the manufacturer's instructions and must be inspected and approved by him prior to system commissioning. The leak detection system shall be as manufactured by Raychem/TraceTek Product Group, Sigma Piping or approved equal. The leak warning signal from the leak detection system shall provide a dry contact signal to the Central Building Automation System (BAS). Wiring from the leak detection system to the BAS shall be provided by the ATC Contractor.
    b. Design Requirements

        1) Provide centralizers as required to position the primary pipe within the secondary pipe so that there is minimum 3/4" clearance at the bottom of

the pipe throughout the system. Clearance must take into account the opening under the centralizer; the amount of space at the inside radius at branches, elbows, and sweeps; the size of weld or glue beads; and the actual space between the inner and outer pipe dimensions.

2) To facilitate installation, access ports (nominal 4" diameter) are required at periodic locations throughout the piping system:

   a) At the beginning and end of every branch and at the beginning and end of the piping system. Ports should be positioned downstream of a sweep so that the sensing cable does not have to be pulled back up the pipe and then down the branch.
   b) If the annular clearance is less than 1", access is required for every 180° of accumulated pipe bend. For example, if elbows are 90°, an access port is required after (2) elbows. Access is required every 250'-0" along straight runs.
   c) If the annular space is 1" or greater, access is required for every 360° of pipe bends and for every 400'-0" of pipe.
   d) Clearance and access port requirements must be met during installation to allow pull ropes to be installed from access to access during pipe construction. These ropes must have minimum 300 lb. pulling strength and minimum 1/4" diameter. Pull ropes should not be glued down, tied to inner piping, or in any way obstructed from free movement within the annular space. Any changes in the pipe layout resulting from job conditions need to address the clearance and access requirements.
   e) Prior to installation of leak detection system, the annular space must be clean, dry, and tightness tested. This can be done by pulling rags through the annular space and/or using dry air to remove residual liquids.

c. System Requirements

1) The leak detection system shall be completely UL listed and FM approved. The system shall be modular and preconnectorized at the factory.
2) The system shall have a sensitivity control to set the threshold at which the system will alarm. The sensitivity setting will depend on the target liquid (water, acid, base, hydrocarbon, solvent, DI water) and can vary from 1/8" to 8" of wetted length. System detection capability shall be constant ±5% over entire cable length.
3) Sensing cable shall be capable of multiple branching. Sensing cable shall be all fluoropolymer construction with no exposed metal parts. All construction shall provide corrosion resistance to acids, bases, and water in the event of exposure.
4) Sensing cable shall be insensitive to pressure. It shall also be insensitive to the presence of non-conductive liquids, including fuels

and solvents. Additionally, the sensing cable shall be insensitive to conductive liquids including water, acids and bases, as applicable.

d. Installation of System

1) Power requirement for the alarm module will be a 15 ampere/115 VAC circuit.
2) Conduit shall be provided from the alarm module location to the start of the piping system to connect jumper cable to sensing cable.
3) Provide a feed-through or penetration into the annular space at the start of the sensing cable.
4) Sensing Cable Installation

a) Sensing cable shall be installed after the piping has been cleaned, dried, and tested for tightness. Sensing cable shall be pulled in from access to access using pull ropes. Installation shall comply with the manufacturer's installation instructions.
b) The HVAC Contractor shall provide a map of the system, which shall be mounted near the alarm module. The map shall indicate access ports and footage readings at periodic locations along the system.

5) The leak system shall be commissioned upon completion of the installation. The condition of the sensing cable shall be measured and recorded with a portable test box. Acceptable total current leakage shall not exceed 10 mA on the system.
6) The HVAC Contractor shall retain the services of the system manufacturer to supervise and commission the installation. A report indicating the results must be submitted to the Architect for his review and records.

D. At the HVAC Contractor’s option, flexible, double-wall fuel oil piping (Class FO-FLEX) may be utilized for exterior, underground fuel oil piping systems.

1. The retractable underground fuel primary piping system shall be comprised of UL/ULC listed primary and secondary components for use with petroleum products and/or alcohol-gasoline mixtures. The piping system must be installed per the manufacturer’s instructions and all federal, state and local codes and regulations. The installed system shall have the capability of pressure testing the primary and secondary piping at regular time intervals. The primary and secondary system shall be installed with the correct pipe slope for fluid leakage monitoring. The piping shall be equivalent to Total Containment, Inc., EnviroFlex System, Environ or APT and shall meet the following criteria:
2. The primary pressure piping shall:

a. Be continuous from tank sump to dispenser sump or transition area.
b. Have all pipe joints secondarily contained and accessible by maintenance personnel.

c. Have a minimum pressure rating of 50 psig.
d. Have a minimum burst pressure of five (5) times the rated pressure.
e. Be flexible and have a minimum bend radius of 12 inches or less without kinking, breaking or cracking.
f. Be installed per NFPA 30 Flammable and Combustible Liquids Code and current industry standards.
g. Be installed when ambient temperature are between 0°F and 120°F.
h. Have sufficient strength to not collapses under full vacuum.
i. Have corrosion resistant UL/ULC tested fittings.
j. Use a cone seat with a metal washer to seal the primary fitting to transition adaptor fittings.
k. Primary pipe must be retractable.

3. The secondary containment piping shall:

a. Be continuous from tank sump to dispenser sump or transition area.
b. Have all pipe joints secondarily contained and accessible by maintenance personnel.
c. Use components that allow the secondary pipe to be air tested at regular time intervals to ensure secondary integrity.
d. Be flexible and have a minimum bend radius of 24 inches without kinking, breaking or cracking.
e. Be installed per NFPA 30 Flammable and Combustible Liquids Code and current industry standards.
f. Be installed when ambient temperatures are between 0°F and 120°F.
g. Be able to withstand “H-20” burial loads in accordance with AASHTO M294.
h. Be large enough to remove and replace the primary without excavation of site.

4. The piping sumps shall:

a. Be fluid resistant to all internal and external UL test fluids, including alcohols.
b. Must provide access to the primary and secondary piping joints.
c. Allow visual inspection of all joints.
d. Have a UL listed frame for mounting of shear valves.
e. Use sump penetrations resistant to fuel spills and exterior soil variations per UL157 and sump bulkhead specifications.
f. Use bulkheads that provide protection to the primary fittings and allow the primary to be removed without damage to the water-resistant secondary.

5. Primary and secondary piping terminations:

a. Terminations above grade shall be completed in compliance with all relevant safety codes and maintain a water-resistant seal.

2.4 FUEL OIL PUMPING AND STRAINING SET

A. Acceptable manufacturers subject to compliance with the specifications:

1. Hayes Pump
2. Preferred Utilities
3. Viking Pump
4. Phillips Pump

B. Provide and install factory assembled "Packaged" Duplex Fuel Oil Pump Set The set shall be piped and wired, with components mounted on a steel base support fabricated of 3/8" steel plate with 4" steel side rails continuously welded to the base. Standard base plate shall encompass the entire perimeter of the duplex pumpset and no components or factory piping shall overhang this base.

C. Base support to be fabricated with 2 3/4" overflow lip which forms a minimum 6-gallon pump set Containment Basin. Base shall be grouted in the field to the housekeeping pad to minimize vibration and movement. In the Rupture Basin shall be a sensor for leak detection.

D. Visual and audible alarm and annunciation for the pump set rupture basin leak alarm shall be located on the pump set control cabinet.

E. Provide a 1/2" plugged drain connection in the Containment Basin. The base shall be provided with steel brackets for mounting and support of the electrical control cabinet.

F. The Set shall consist of but not be limited to the following components:

1. Two (2) Fuel oil pumps shall be of the size, capacity and horsepower as scheduled when operating with the oil grade as indicated on the drawings and as specified under other sections of this specification Each pump shall be flexibly coupled to a 1750 / 1140 rpm NEMA frame TEFC motor, capable of operating on the electrical service as scheduled.
2. Pump housing shall be constructed of high quality close grain cast iron. Pumps with aluminum or bronze bodies will not be accepted. Body to be constructed to permit disassembly and removal of rotors without breaking piping connections.

    a. Pump gears shall be of the double helical herringbone type, designed to provide a smooth, pulsationless flow of fluid. The rotor is to be in hydraulic axial balance so as to eliminate end thrust.
    b. Pump shall have carbon steel, machined and ground shaft.
    c. Pump shall have a Crane 21 type mechanical seal in lieu of packing or lip seal.
    d. Pump shall be equipped with heavy duty anti-friction roller bearings. Bearing support shall be provided at both ends of the driving and driven shaft.

3. Provide one (1) Duplex fuel oil strainer for the suction side of each pump set, sized to produce less than 1/2" of mercury drop through a clean strainer basket with the maximum anticipated flow in the suction line.

a. Strainer shall be equipped with a differential pressure switch to indicate that the basket needs to be cleaned. Switch shall provide indication on the main pumpset control cabinet to alert operators.
b. Strainer shall have (1) piece cast iron body and shall be suitable for pressure to 200 psi. Strainer baskets to be fabricated of bronze.
c. Strainer shall come complete with lever wrench handle.
d. Strainer to be No. 50 similar to Hayward.

4. Fuel oil pump relief valves shall be sized to relieve the full flow of the pump without causing the pump motor to overload or any component's pressure rating to be exceeded if the discharge is inadvertently valved off.

    a. Valves shall be externally mounted on the set to be piped to the return line in the field. Internal relief valves will not be accepted.

5. Provide check valves on the discharge side of each pump.
6. Ball valves shall be provided on both sides of each pump to provide pump isolation for service.
7. Provide two (2) 4" Dial compound gauges, one on each side of suction strainer. Gauges shall be liquid filled to dampen pulsation, with bright finished stainless steel case, brass movement, bronze bourdon tube, and shall be furnished with a pulsation dampening orifice. Gauge shall and read 30" vacuum - 15 psig. Gauges shall be mounted with isolation cocks.
8. Two (2) 4" Dial pressure gauges shall be placed on the discharge side of each pump. The gauges shall be liquid filled to dampen pulsation, have bright finished stainless steel case, brass movement, bronze bourdon tube, and shall be furnished with a pulsation dampening orifice. All gauges shall be readable from the front of the set, at a distance of not less then 20'-0". Gauge shall read 0 to 160 psig. Gauges shall be mounted with isolation cocks.
9. Provide flexible coupling and full OSHA approved coupling guard. Pumps and motors shall be mounted bolts threaded into the steel channel for ease of maintenance. Mounting bolts shall not penetrate the secondary containment basin.
10. Provide a time delayed flow sensing switch on the discharge of the pumpset to bring on the lag pump should one of the pumps fail to maintain flow in the loop. Switch will be wired back to the main control cabinet for alarm and annunciation.
11. The pumps shall be connected to the piping in the system through stainless steel flex hoses with braided jackets provided by the pump set manufacturer.

G. Fuel Oil Pump Control Center

1. Provide a factory wired and tested NEMA 1 control panel. Control Panel shall consist of but not be limited to the following:

    a. Main power disconnect with door interlock. .
    b. Magnetic motor starters with overload protection.
    c. Motor circuit breakers.
    d. Control circuit transformer if main power exceeds 120 volts..
    e. ETM time elapse recorders to measure running time for each pump.

f. H-O-A switches for each pump.
g. Lead pump alternator logic for normal cycling and pump failure conditions.
h. Lead pump selector switch, with alternating lead/lag.
i. Alarm bell with silence pushbutton.
j. Common alarm output to interface with the BMS.
k. Strainer basket high differential alarm.
l. Alarm and annunciation for each RBS leak switch in the containment pipe that runs throughout the building. (See drawing for detail)
m. Indicating lights as follows:

1) Pump running
2) Pump failure
3) Containment pipe leak
4) Pumpset containment basin
5) Strainer basket high differential warning light

2.5 TANK MANIFOLD CONTROL

A. Acceptable manufacturers subject to compliance with the specifications:

1. Hayes Pump
2. Preferred Utilities
3. Earthsafe Systems
4. Phillips Pump

B. General: Provide a tank manifold control system including tank level sensors, control valves, and an electronic control module. The manifold system allows a duplex pump set to draw fuel from multiple fuel storage tanks. The tank flow is controlled by actuated inlet and outlet valves. A low level condition on the primary tank automatically switches supply to alternate tanks.

C. Design Criteria

1. Control Module: The tank manifold system shall be controlled by a microprocessor based control module. The module shall have output relays with surge suppression to activate solenoid valves at the tank inlet and outlet. The unit shall receive a signal from a tank low level to automatically switch fuel supply and return to a secondary tank or tanks. The module shall have exterior hand-off-auto mode selector switches for each tank. Indicator lights shall be provided for power on, tank standby status, tank active status, and tank low level alarm. The control module shall interface with the pump control module so that solenoid valves are activated only when the pump is on.
2. Low Level Sensors: The low level sensors shall be provided at approximately the tank 5 % fill level to provide a signal to the control module. The level switch shall be stainless steel construction.
3. Solenoid Valves: Solenoid valves for the tank inlet and outlet shall be brass construction, normally closed with 120 VAC coils and NEMA 4 enclosures. The valves shall operate at zero pressure differential.

PART 3 - EXECUTION

3.1 EXCAVATION

A. Excavation, trenching, and backfilling are specified in Division 2.

3.2 FUEL TANK INSTALLATION

A. Install tanks in strict accordance with the manufacturer's recommendations, PEI/RP100 and PEI-RP200, and applicable fire and environmental codes. State and local permits shall be obtained prior to installation.

B. Electrical work shall be in accordance with applicable codes and shall be rated for hazardous area as required. Tanks shall be electrically grounded in accordance with N.F.P.A. 78.

C. The tank installation shall be inspected and approved by the tank supplier or its certified contractor. The tank supplier shall submit a comprehensive check-list of quality and safety items critical to the system and verify that the installation has been in accordance with these standards and applicable fire and environmental codes.

3.3 ABOVEGROUND PIPING INSTALLATION

A. Install in accordance with the manufacturer's instructions and PEI/RP200-92.

B. Inspect all materials for signs of damage, and confirm compliance with specifications.

C. Avoid damage to piping materials or coatings during handling, installation and testing.

D. Provide adequate support for piping on 10' centers minimum.

E. Group piping whenever practical at common elevations.

F. Install piping to allow for expansion and contraction so that pipe, joints, or connected equipment will not be stressed.

G. Provide clearance for access to valves and fittings.

H. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of the completed system.

I. Install unions, couplings, valves, and flexible connectors in accordance with manufacturers' recommendations.

## 3.4 UNDERGROUND PIPING INSTALLATION

A. Install in accordance with manufacturer's instructions and PEI/RP200-92.

B. Inspect all materials for signs of damage, and confirm compliance with specifications.

C. Avoid damage to piping materials or coatings during handling, installation and testing.

D. Secondary containment piping must slope to piping sump at a minimum 1/8" per foot.

E. Trench and backfill per manufacturer's instructions.

F. Test primary and secondary pipe for integrity using pressurized air per manufacturer's instructions.

G. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work and isolating parts of the completed system.

## 3.5 TANK LEVEL AND LEAK MONITORING SYSTEM INSTALLATION

A. Install in strict accordance with the manufacturer's recommendations, National Electrical Code NFPA 70, and NFPA 30A.

B. Electrical work shall be rated for hazardous area as required.

C. Install the monitoring system control panel as indicated on the drawings.

D. Install the tank level probe and the interstitial leak probe in the proper locations in the fuel tank. Install the piping sump sensor in the piping sump.

E. Install the overfill alarm and acknowledgment switch as shown in the plan.

F. The leak monitoring system installation shall be inspected and approved by the equipment supplier or its certified contractor. The leak monitoring system supplier shall submit a comprehensive check-list of quality and safety items critical to the system and verify that the installation has been in accordance with these standards and applicable fire and environmental codes.

## 3.6 FIELD QUALITY CONTROL

A. Test fuel distribution system according to NFPA 30. Replace leaking joints and connections with new materials.

B. Test and adjust fuel management and leak monitoring systems controls and devices. Replace damaged and malfunctioning controls and devices.

C. Submit reports of test and procedures in writing to the Engineer.

## 3.7 DEMONSTRATION

A. Train Owner's maintenance personnel on procedures and schedules related to start-up and shutdown, troubleshooting, servicing, and preventive maintenance.

B. Representatives of equipment suppliers for the fuel tanks, fuel pumps and leak monitoring system shall provide necessary training and technical support to the Owner so that the Owner may properly operate and maintain the systems.

## 3.8 START-UP

A. Before activating the system perform these steps:

1. Flush system piping with grade of fuel to be used by owner to remove any debris and foreign matter in piping prior to filling tank for the first time. Service all system filters and screens and dispose of fuel in accordance with EPA and NFPA regulations after flushing.

B. Perform a complete system commissioning in accordance with the approved commissioning plan.

END OF SECTION